Ecology 203, Exam II. 3-3-04. **Print name:**_____

Rules: Read carefully, work accurately and efficiently. If you are concerned please leave marginal comments for me.

$N_t = N_o\lambda^t$ $\quad$ $N_t = N_o e^{rt}$

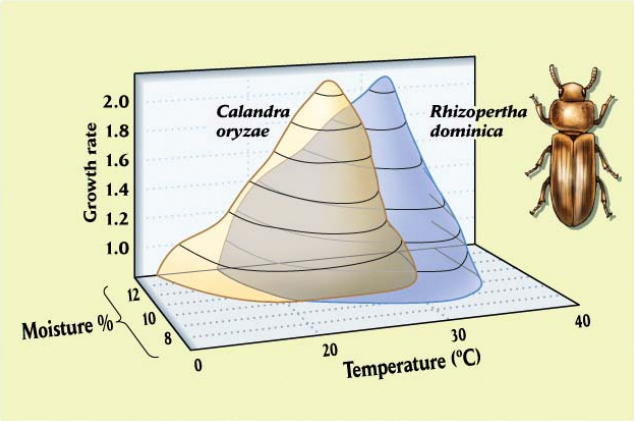
$dN/dt = r_oN(1-N/K)$ $\quad$ $\frac{N_{\text{captured and marked initially}}}{N_{\text{total}}} = \frac{N_{\text{marked at recapture}}}{N_{\text{total recaptured}}}$

$dp/dt = cp(1-p) - ep$ which suggests the equilibrium proportion of occupied patches $p = 1 - e/c$

$N_{t+1} = N_t + r_oN_t(1-N_t/K)$ $\quad$ $N_t = K/(1 + [(K - N_o)/N_o] * e^{-rt})$

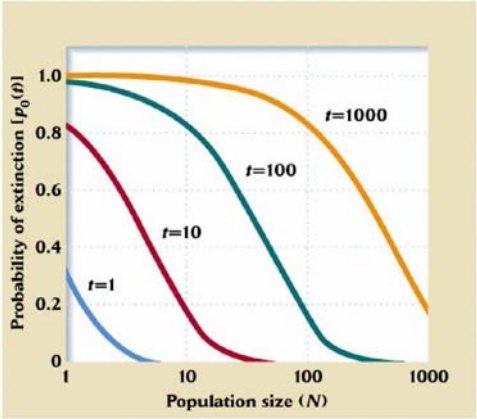
Multiple choice. (3 pts each; 42 pts total)

1. What is the doubling time of a population that grows from a starting population of 95 to 100 in just one year?
   a. 10 years
   b. 12.5 years
   c. 13.5 years
   d. 15 years
   e. 20 years
2. Which of the following is an assumption of the logistic growth model? [L]
   a. Individuals are not limited in their ability to find mates.
   b. Per capita (per individual) growth rate decreases linearly as a function of density (N).
   c. Population doubling time is not dependent on density.
   d. All of the above are assumptions of logistic growth.
   e. None of the above are assumptions of logistic growth.
3. If you have collected data on age-specific survivorship and fecundity the best model choice would be
   a. exponential growth.
   b. geometric growth.
   c. the Leslie matrix approach.
   d. any one of the above modeling approaches – they're all equally useful.
   e. none of the above – modeling populations can't be done and if done, will be useless.
4. The data in the graph on the right, taken from your textbook, suggest that the two beetle populations [TB: 283]
   a. are not regulated.
   b. are regulated by moisture and temperature.
   c. are increasing together.
   d. are builders of colony mounds under fixed environmental conditions.
   e. have similar, although slightly different, environmental requirements for growth.



5. To achieve the highest possible level of fecundity, male dragonflies will (after fertilizing the female's eggs): **[SS]** [FG: 371]
   a. Practice mate guarding and contacting guarding to help ensure the deposit of the eggs.
   b. Practice predator mobbing to keep away any animal that would consume the female.
   c. Do nothing because after eggs are fertilized, they naturally have a high chance of survival to the next phase of life.
   d. Do nothing because most male dragonflies are not aggressive.
   e. do all of the above.

6. If a population's birth rate (b_o) and death rate are independent of density **and** numerically different ($b \neq d$) the population must be: [L] [Hint: a make graph for yourself if necessary]
   a. growing.
   b. decreasing.
   c. in a stable equilibrium.
   d. experiencing chaotic fluctuations.
   e. we don't know enough to determine this.
7. When "self-thinning" in plants takes place the population density [L; TB: 288-9]
   a. goes up while average plant size increases.
   b. goes up while average plant size decreases.
   c. goes down while average plant size increases.
   d. goes down while average plant size decreases.
   e. none of the above.
8. Assume that a bird species around Geneseo functions as a metapopulation over this region and there are 100 possible occupied patches. If the extinction rate from patches is 0.4 and the colonization rate is 0.5 you should expect the equilibrium number of occupied patches to be [L; TB: 303]
   a. 20.
   b. 40.
   c. 60.
   d. 80.
   e. 100.

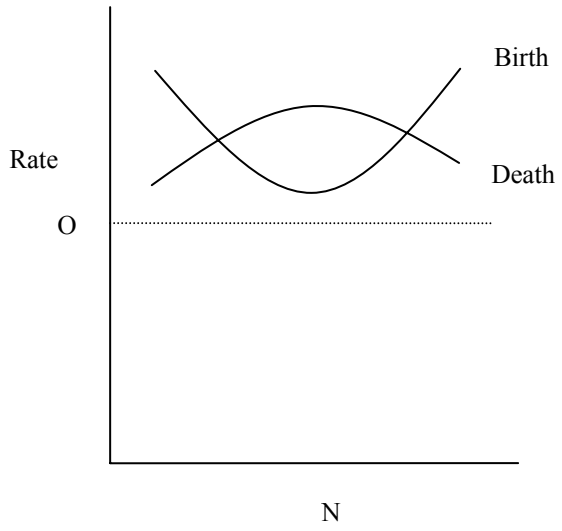


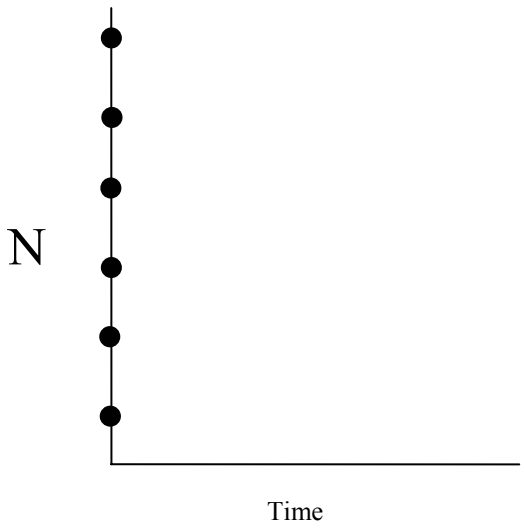
9. The graph to the right suggests (L; TB 307]
   a. populations decrease over time.
   b. populations increase over time.
   c. the probability of extinction increases with time.
   d. the probability of extinction increases with N.
   e. these populations are decreasing logistically.
10. In a life table "l_x" represents
   a. the latency period of parasites.
   b. the longevity of a species.
   c. the life expectancy of species.
   d. the survivorship probability of individuals.
   e. the survivorship probability of the species.
11. If a species occupies 10 patches and each patch has a likelihood of going extinct equal to 0.9 (90% chance of each patch becoming empty in a single time step) the probability that the population will persist one time step is [L]
   a. 0.25
   b. 0.65
   c. 0.75
   d. 0.90
   e. 1.90
12. Andrewartha and Birch collected data on thrips populations and analyzed them using multiple regression. Their results suggest that [L]
   a. populations are not regulated.
   b. populations are regulated primarily by density-independent factors.
   c. populations are regulated primarily by density-dependent factors.
   d. all of the above work equally to regulate populations.
   e. none of the above.

13. We discussed the following three related but different models for populations. These were the metapopulation model, the source-sink model, and the landscape ecology model. The are all similar except for which of the following characteristics: [L, TB: 259]
    a. populations are divided into patches.
    b. some patches are occupied while others are not.
    c. individuals are able to move amongst the patches.
    d. some patches are better than other patches.
    e. none of the above (the characteristics above apply to all three models).
14. The model in which the habitat matrix is viewed as the only barrier to individuals movement between subpopulations is: **[SS]**
    a. exponential growth model
    b. leslie matrix model
    c. metapopulation model
    d. source-sink model
    e. landscape model

Short, precise answers. **Choose 4 of 6**. Use only the space provided. (10 pts each; 40 pts total)

1. **Analyze the graph** on the left and provide a new graph of N vs. time on the right. Be sure to explore different initial population sizes in the graph on the right. Mark equilibria on both graphs. Use the dots and project what should happen to N over time based on the information in the graph on the left.





2. Your professor has growth rate parameters for two populations. Species A grows with $\lambda = 1.5$ while species B grows with $r = 0.5$. If both start off with 500 individuals what will their populations be over the next 5 years? Note that we start at N_o and that you need to iterate these up to N_5. Fill in the table. Please ***provide just one graph*** of N vs. time that shows both species on it. Be accurate - use your calculator and clearly label your axes and lines/points for the two species.

Year	Species A	Species B
0	500	500
1		
2		
3		
4		
5		

3. Below please draw the three survivorship curves on one graph, label them and the axes, and provide an example for each.

4. Provide three graphs (assume logistic growth): 1. dN/dt (instantaneous rate of change of a population) as a function of body size. [based on lecture] 2. Territory size as a function of body size. [based on lecture] 3. dN/dt as a function of territory size. [New!] Explain why you think population growth rate (dN/dt) is related to territory size the way you have drawn it.

5. Draw a map in the box below of the dispersion pattern for a single population that is random, uniform, and clumped **at different scales** (this is not three different patterns in different parts of the map). Please provide dots that indicate the location of each individual. Indicate **very clearly** where the three patterns exist in your single map. (key words = "dispersion pattern" and "scale")

6. You wish to estimate the population of eastern cottontails in the Arboretum. You decide to use the Lincoln-Peterson mark-recapture method you learned in Ecology 203. You set up bunny traps in open patches, catch 50, mark them with yellow paint, and release them. One week later you trap bunnies in a similar way and catch 120, 25 of which are marked.

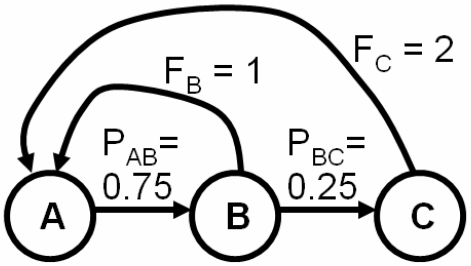
   a. What is your estimate of the bunny population in the Arboretum? (4 points)

   b. On the day of your second sampling it turns out there is very popular bunny conference on predator avoidance, held in a field neighboring the Arboretum. Marked bunnies feel relatively insecure and are more likely to attend the conference than unmarked bunnies. Describe how this would affect your estimate of the population. (6 points)

Mandatory questions (2). Use only the space provided. (18 points total)

1. Population growth based on life history data (14 points)

   1a. Provide the Leslie matrix for the figure. Assume that the P_{AB} and P_{BC} are age-specific survival probabilities and that F_B and F_C are age-specific fecundity rates. (5 points)



1b. Using your Leslie matrix from above, calculate the population at time step **4** if at time step **0** there are 50 babies, 75 juveniles, and 100 adults. Show your work. (5 pts)

1c. How should you determine λ for the above population? (2 pts)

1d. Using your suggestion above in #1c calculate λ. (2 pts)

λ = _____ (show your work).

2. What are the four, easily observed characteristics of natural selection? (4 pts)

a. _____
b. _____
c. _____
d. _____

Extra Credit

1. Assume the chicken influenza strain was brought to SUNY Geneseo by a single student. Provide a graph (not map) of what its spread would look like (label axes clearly) and explain why it would do this. The graph should show the dynamics from the initial infection until the disease died out (ran its course). (3 points)

2. If the population of species A is experiencing competition with B it might be modeled usuing the following equation: $dN_A/dt = r\, N_A\, (1 - N_A - \alpha N_B)/K_A$. Here N_A = number of individuals of species A and N_B the number of species B. "α" = the competition coefficient and defines the relative strength of competition of individuals of species B on individuals of species A. What would α be if (5 pts)

   a. species A and B do not compete?

   b. the effect of individuals of B on A is the same and the effect of individuals of species A on species A?

   c. explain: